

PATENT ABSTRACTS OF JAPAN

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(54) IMAGE OBSERVATION DEVICE

(57)Abstract:

PURPOSE: To reduce the reflection of external light, entering the image observation device having at least one optical system between a liquid crystal display device, etc., and the eye of an observer, and make an image easy to see by arranging a polarizing

element between the optical system and eye.

CONSTITUTION: In the image observation device like an electronic finder which enables an image formed by the liquid crystal display device LCD, etc., to be observed through a lens 5 as the optical system, a polarizing filter 6 which has the axis of polarization set to the same direction with the eye-side polarizing plate 4 of a liquid crystal panel 3 constituting the LCD is arranged between the lens 5 and eye. The external light is transmitted through the polarizing filter 6 twice when made incident on the electronic finder from the eye side and exiting to the outside after being reflected inside. The light emitted from the LCD, on the other hand, is already polarized, so the intensity after the light is transmitted through the polarizing filter 6 is affected only by the parallel transmissivity. The ratio of the external light of the LCD made incident on the eye to the reflected light of the external light can be improved by as much as the reflected light of the external light is reduced.

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CLAIMS

[Claim(s)]

[Claim 1] Image observation equipment characterized by having arranged the polarizing element between said optical system and eyes in the image observation equipment which arranges at least one optical system and changes between the display which constitutes an image by polarization, and an observer's eye.

[Claim 2] the polarizing element of two sheets -- containing -- **** -- this -- the image observation equipment which arranges the liquid crystal cell and optical system which form an image, and changes between the polarizing elements of two sheets.

[Claim 3] the polarizing element of three sheets -- containing -- **** -- this -- the image observation equipment arranged between the liquid crystal cells and optical system in which one in the polarizing element of three sheets forms an image.

[Claim 4] It is image observation equipment according to claim 3 with which said the first sheet and handsome polarizing element is arranged from the eye side so that the polarization direction may become a real Kamitaira line.

[Claim 5] Said optical system is image observation equipment given in claim 1 thru/or any of 4 they are. [which consists of the single glass lens]

[Claim 6] the polarizing element of two sheets -- this -- the image observation equipment which includes the liquid crystal cell and optical system which form the image arranged between the polarizing elements of two sheets, arranges the wavelength plate which produces $\lambda(2n+1)/4$ (however, wavelength of $n=0, 1, 2$ and $3, \dots$, $\lambda = \text{light}$) of phase contrast, respectively, and changes between said polarizing elements and said liquid crystal cells.

[Claim 7] Said wavelength plate of two sheets is image observation equipment according to claim 6 which shaft orientations were parallel or lay at right angles, and has been arranged so that the include angle of 45 degrees may be made to said polarizing plate.

[Claim 8] Image observation equipment which consists of the polarizing element arranged so that the include angle θ to which the normal stood to the front face is satisfied with an eye side of the following conditions to an optical axis from a back light, a polarizing plate, the display equipped with the liquid crystal cell, and this display may be made and it may incline in order to form an image by polarization, and an ocular.

$(\theta_1 + \theta_2) / 2 < \theta < 85 \text{ degrees}$, however θ_1 The incident angle of the beam of light which carries out incidence from an eye point to the edge of a screen in a flat surface including the above-mentioned normal and optical axis of the polarizing plate by which **** arrangement was carried out, and θ_2 The intersection of said beam of light and polarizing plate which carry out incidence to the edge of a screen

When the side which has Intersection P on both sides of the optical axis in the point that only distance l left the distance between H and Intersections P and H from Intersection H, from hp and Intersection H in the intersection of the perpendicular and optical axis which were given from P and Intersection P to the optical axis sets the height to a reverse near equipment frame to hl in the range to an eye point, It is the minimum value of the value expressed with $\tan^{-1} (hp+hl) / l$.

[Claim 9] Image observation equipment which has arranged this liquid crystal display so that it consists of a back light, a liquid crystal display, and an ocular in order to form an image by polarization, and the normal stood to the front face of this liquid crystal display may make the include angle theta with which are satisfied of the following conditions and may incline to an optical axis.

$(\theta_1 + \theta_2) \leq \pi/2$, however θ_1 The incident angle of the above-mentioned normal of the liquid crystal display by which skew arrangement was carried out, and the normal which carries out incidence from an eye point to the edge of a screen in a flat surface including an optical axis, and θ_2 When the side which has Point R on both sides of the optical axis in the point that only distance m left the distance between H', H', and R from intersection H', from hr and intersection H' in the intersection of the perpendicular and optical axis which gave the point of the edge of a screen from R and R to the optical axis sets the height to a reverse near equipment frame to hm in the range to an eye point, It is the minimum value of the value expressed with $\tan^{-1} (hr+hm) / m$.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the image observation equipment like the finder for camcorders, or a still video finder which enabled it to observe the image formed by the liquid crystal display etc. through optical system.

[0002]

[Description of the Prior Art] In this kind of image observation equipment, if light goes into the interior of equipment from the exterior, an image will benefit that reflected light hard to see. Therefore, conventionally, a part for a hood was improved, and

outdoor daylight was made not to carry out incidence inside equipment, or the antireflection film etc. was given to the reflector inside equipment, and measures, such as reducing a reflection factor, were taken.

[Problem(s) to be Solved by the Invention]

[0003] In the camera of the electronic image field, the finder of the method which expands and looks at screens, such as CRT and LCD, by optical system from the former has been used. However, even if it takes a cure, such as reducing the above reflection factors in dark LCD of a screen compared with CRT, in addition, reflection of the outdoor daylight by the finder lens side or the LCD front face cannot be disregarded, but it has been a problem.

[0004] Moreover, although a gobo must be enlarged more in order to prevent penetration of the outdoor daylight into a finder efficiently, in the case of the method using the **** gobo and hood which were proposed in JP,1-146227,U, the part of this which touches an observer's skin directly at the time of about [making handling and carrying of finder equipment inconvenient] and observation increases, and there is a trouble it is told to an observer that gives displeasure in it. Moreover, when an antireflection film is used, there is also a problem referred to as becoming a cost rise.

[0005] The place which this invention is made in view of such a trouble that a Prior art has, and is made into the purpose is to offer the image observation equipment which can be made to be able to reduce more reflection of the outdoor daylight which advanced into the interior, and can raise the vanity of an image.

[Means for Solving the Problem]

[0006] In order to attain the above-mentioned purpose, the image observation equipment by this invention is equipped with the polarizing element arranged between at least one optical system arranged between the image display device like a liquid crystal cell, and an image display device and an observer's eye, and this optical system and an eye.

[0007] Two polarizing elements may be used by arrangement which sandwiches a liquid crystal cell and optical system, and may be used three sheets by the arrangement between which the polarizing element of one more sheet was made to be placed between a liquid crystal cell and optical system. In this case, from the eye side, it is arranged so that, as for the first sheet and handsome polarizing element, the polarization direction may become a real Kamitaira line. Moreover, optical system is a single glass lens and the wavelength plate which produces $\lambda/4$ (however, wavelength of $n=0, 1, 2$ and $3, \dots, \lambda = \text{light}$) of phase contrast $(2n+1)$ may be arranged between the polarizing element and the display. Furthermore, the wavelength plate of two sheets is arranged so that shaft orientations are parallel, or may lie at right angles and the include angle of 45 degrees may be made to a polarizing plate.

[0008] Furthermore, a polarizing element may be arranged so that the include angle θ with which are satisfied of the conditions which $\theta_1 + \theta_2 < \theta < 85$

degrees of normals stood to the front face become from a display to an optical axis by the eye side may be made and it may incline. θ_1 [however,] The incident angle of the beam of light which carries out incidence from an eye point to the edge of a screen in a flat surface including the above-mentioned normal and optical axis of the polarizing plate by which **** arrangement was carried out, and θ_2 The intersection of said beam of light and polarizing plate which carry out incidence to the edge of a screen When the side which has Intersection P on both sides of the optical axis in the point that only distance l left the distance between H and Intersections P and H from Intersection H, from h_p and Intersection H in the intersection of the perpendicular and optical axis which were given from P and Intersection P to the optical axis sets the height to a reverse near equipment frame to h_l in the range to an eye point, It considers as the minimum value of the value expressed with $\tan^{-1} (h_p+h_l) / l$. Moreover, in this case, a polarizing plate is arranged, as it is in the field where that transparency shaft includes the above-mentioned normal and an optical axis.

[0009] It inclines and an image display device may be arranged so that the conditions which the angle θ of the normal of the front face and an optical axis $2<\theta$ $[(\theta_1+\theta_2) /]$ Becomes may be satisfied. θ_1 [however,] The incident angle of the beam of light which carries out incidence from an eye point to the edge of a screen in a flat surface including the above-mentioned normal and optical axis of the display by which **** arrangement was carried out, and θ_2 An intersection with the screen of said beam of light which carries out incidence to the edge of a screen When the side which has Intersection R on both sides of the optical axis in the point that only distance m left the distance between H', and Intersection R and H' from intersection H', from h_r and intersection H' in the intersection of the perpendicular and optical axis which were given from R and Intersection R to the optical axis sets the height to a reverse near equipment frame to h_m in the range to an eye point, It considers as the minimum value of the value expressed with $\tan^{-1} (h_r+h_m) / m$.

[0010]

[Function] In an electronic finder (henceforth EVF) like the finder for camcorders, or a still video finder, reflection of the outdoor daylight used as the cause of the difficulty of being visible is mainly a thing from a lens front face and the front face of a display. According to this invention, since the polarizing element is arranged in EVF at the side near [liquid crystal display / (henceforth LCD)] an eye, outdoor daylight and its reflected light can be attenuated without attenuating the light which forms the image which should be observed, and vanity is raised.

[0011] Namely, as shown in drawing 1 , the polarizing filter 6 with which the polarization shaft was arranged with the polarizing plate 4 and the same direction by the side of the eye of the liquid crystal panel 3 which constitutes LCD between the lens 5 as optical system and an eye is arranged. It is [luminous intensity / which comes out of the luminous intensity by which the outdoor daylight which carried out

incidence from the eye side in the conventional EVF reflects inside EVF, and goes into an eye from R and LCD, and goes into an eye] TP in the permeability of S and a polarizing filter 6 about the parallel permeability (permeability of polarization parallel to a polarization shaft) of T and a polarizing filter 6. If it carries out Since outdoor daylight will penetrate the 2 times polarizing filter 6 when reflecting in the time of the incidence to EVF, and the interior, and injecting to the exterior, the reinforcement N is set to $T \times TP \times R$. On the other hand, since the light which came out of LCD is already polarizing, the reinforcement S after penetrating a polarizing filter 6 is set to $TP \times I$. Here, if a S/N ratio is taken, it becomes $(TP \times I) / (T \times TP \times R) = (1/T) (I/R)$, and since it is $T < 1$, a S/N ratio will improve.

[0012] Moreover, in the above-mentioned configuration, although there are two polarizing elements which arranged the polarization shaft with the same direction on both sides of the lens 5 in the eye side of a liquid crystal panel 3, since there should just be one of sheets of this in order to see an image, the polarizing plate 4 by the side of the eye which constitutes LCD as shown in drawing 2 may be removed. An operation of the removed polarizing plate 4 can be executed by proxy with a polarizing filter 6, and the intensity of light of an image is set to I as well as the case of drawing 1 in this case. If a S/N ratio is taken here, it becomes $I / (T \times TP \times R) = [1 / (T \times TP)] \times (I/R)$, and since it is $TP < 1$, a S/N ratio will improve more.

[0013] By arranging a polarizing element to the EVF side nearest to an eye as mentioned above, the incident light and the reflected light to EVF can be attenuated, the S/N ratio of an image can be raised, and vanity can be improved.

[0014] moreover, the polarizing plate 2 by which turned LCD to the eye side from the back light 1 side, and the sequential array was carried out as shown in drawing 9 and $\lambda/4$ wavelength plate 12 ($n = 0, 1, 2$ and 3], and ...) If constituted from the wavelength, the liquid crystal cell 3, $\lambda/2$ wavelength plate 13 ($m = 0, 1, 2$ and 3], ...), and polarizing plate 4 of $\lambda/4$ light Since it will pass along a wavelength plate 13 twice and 90 degrees of sense of plane of polarization rotate, the reflected light from the field which is in an eye side from the rear face of the liquid crystal cell 3 which becomes harmful when observing an image among the light which carried out incidence from the eye side and penetrated the polarizing plate 4 is almost absorbed with a polarizing plate 4. Thereby, reflection in the liquid crystal cell 3 interior can also be decreased. On the other hand, although the light by the side of a back light 1 turns into the linearly polarized light and turns into the circular polarization of light by passing a wavelength plate 12 by passing along a polarizing plate 2, since it becomes the linearly polarized light again and incidence is carried out to a polarizing plate 4 by passing a wavelength plate 13, it can obtain an image as usual.

[0015] Moreover, as shown in drawing 10 , when the angle theta of the normal and optical axis which were stood to the front face of a polarizing plate 6 to make fills conditional expression $(\theta_1 + \theta_2) / 2 < \theta < 85$, the light which carried out

incidence and which came out of the eye point EP, and was reflected on the front face of a polarizing plate 6 in the finder does not come outside in a frame. Conversely, if it thinks, even if the light which carried out incidence from outside reflects on the front face of a polarizing plate 6, the light will not go into an eye. θ_1 [however,] The incident angle of the beam of light which carries out incidence from an eye point to the edge of a screen in a flat surface including the above-mentioned normal and optical axis of the polarizing plate by which **** arrangement was carried out, and θ_2 The intersection of said beam of light and polarizing plate which carry out incidence to the edge of a screen When the side which has Intersection P on both sides of the optical axis in the point that only distance l left the distance between H and Intersections P and H from Intersection H, from h_p and Intersection H in the intersection of the perpendicular and optical axis which were given from P and Intersection P to the optical axis sets the height to a reverse near equipment frame to h_l in the range to an eye point, It considers as the minimum value of the value expressed with $\tan^{-1} (h_p+h_l) / l$. Furthermore, the reflection factor in a front face takes the value which changes with oscillating directions of light depending on whenever [incident angle]. S component parallel to a reflector increases in monotone as an incident angle increases, and it decreases temporarily as the incident angle of P component contained on the other hand in the field containing the normal and incident ray of a reflector increases, and when an incident angle becomes equal to $\tan^{-1} n$ (n is the refractive index of a polarizing plate 6), it is set to 0. Although it increases in monotone after that, an incident angle serves as an S component \geq P component in 0 to 90 degrees. Moreover, the transmission of P component of the leaned polarizing plate 6 is $\theta = \tan$ by arranging the transparency shaft of a polarizing plate 6 in the direction used as P component. It becomes max near $\tan^{-1} n$, and sufficient transmission can be obtained even if it does not perform coating. Since it decreases as θ of permeability of the outdoor daylight which contains S component in coincidence increases, the reflection by the reflector which is in the LCD side from a polarizing plate 6 decreases.

[0016] moreover, the angle of the normal and optical axis which were stood on the surface of the image display device (LCD) as shown in drawing 11 to make -- θ -- carrying out -- $\theta > (\theta_1 + \theta_2) / 2$ -- when satisfying conditions, the light which came out of the eye point and carried out incidence to the finder and which was reflected a front face and inside the image display device does not come outside in a frame Conversely, if it thinks, even if the light which carried out incidence from outside reflects a front face and inside an image display device, the light will not go into an eye. θ_1 [however,] The incident angle of the beam of light which carries out incidence from an eye point to the edge of a screen in a flat surface including the above-mentioned normal and optical axis of the display by which skew arrangement was carried out, and θ_2 When the side which has Point R on both sides of the

optical axis in the point that only distance m left the distance between H' , H' , and R from intersection H' , from hr and intersection H' in the intersection of the perpendicular and optical axis which gave the point of the edge of a screen from R and R to the optical axis sets the height to a reverse near equipment frame to hm in the range to an eye point, It considers as the minimum value of the value expressed with $\tan^{-1} (hr+hm) / m$.

[0017]

[Example] Drawing 1 shows the 1st example of this invention. the inside of drawing, and F -- for a polarizing plate and 3, as for a polarizing plate and 5, a liquid crystal cell and 4 are [an equipment frame and 1 / a back light and 2 / a glass lens and 6] polarizing filters. In this case, each plane of polarization of polarizing plates 2 and 4 and a polarizing filter 6 is arranged in the same direction, and what has the following property as a polarizing filter 6 was used. In addition, polarizing plates 2 and 4 and a liquid crystal cell 3 constitute LCD.

Simple substance permeability (T) 43% 81.8% (TP) of parallel permeability 4.2% (TC) of rectangular permeability ** Light Whenever 95% [0018] Incidence of the outdoor daylight is carried out to the interior of the equipment frame F from an eye side, and it penetrates a polarizing filter 6, it reflects inside, and it penetrates a polarizing filter 6 again, and goes into an eye. Therefore, the reflected light will pass along a polarizing filter 6 twice, and the intensity of light decreases to 33.5%. On the other hand, in order that the light from LCD may also go into an eye through a polarizing filter 6, unlike the former (at the time of no coping with it), the intensity of light decreases to 81.8%. Therefore, it turns out that the S/N ratio in the case of this example will be set to 2.44 if the S/N ratio at the time of no coping with it is placed with 1, and a S/N ratio improves remarkably. In addition, the antireflection film was given to the front face of a polarizing filter 6 in order to prevent surface reflection of a polarizing filter 6. Since what is necessary is just to add a polarizing filter to EVF which used the conventional LCD, this example can be carried out very easily and cheaply.

[0019] Drawing 2 shows the 2nd example of this invention. This example differs from the 1st example in that the polarizing plate 4 is removed from LCD. Therefore, supposing the surface reflection factor of a polarizing plate 2 and a liquid crystal cell 3 is the same, the strength of the reflected light by the outdoor daylight included in an eye will decrease to 33.5% like the case of the 1st example. On the other hand, since the light from LCD is considered to be what the polarizing plate by the side of the eye of LCD moved to the before [a lens] side with the configuration at the time of no coping with it the same way, if it thinks that there is no strong change, a S/N ratio will be set to 2.99 and its S/N ratio will improve further rather than the 1st example.

[0020] Since the components mark of about [that only the reflected light by outdoor daylight can be reduced] and the LCD section can also be reduced in the 2nd example, without decreasing the brightness of an image, the effectiveness is size. In

this example, in order to prevent the effect by the birefringence of optical system, it is good to constitute an optic from an ingredient which birefringences, such as glass or an acrylic, cannot produce easily. Moreover, since it is the partially polarized light when carrying out incidence into EVF after outdoor daylight reflects once in an observer's face, the outdoor daylight which goes into an eye much more efficiently can be decreased by arranging a polarizing filter and a polarizing plate in the polarization direction and the direction which intersects perpendicularly.

[0021] Drawing 3 shows the 3rd example of this invention. This example is the point of having made it not go into an eye even if it has leaned and arranged and outdoor daylight reflected on that front face so that the normal which stood the polarizing filter 6 to that front face might make θ (about about 45 degrees) to an optical axis, and differs from the 2nd example. Thus, since it is absorbed in the wall of the equipment frame F, the light reflected on the surface of the polarizing element among the outdoor daylight which carried out incidence from the eye side by leaning a polarizing element can reduce the effect of an increment of the reflector by it, even when a polarizing element is added. About the field on the backside [polarizing filter / 6] (back light 1 side), there is the same effectiveness as the 2nd example. As shown in drawing 10 , Above θ the incident angle of the beam of light which carries out incidence from an eye point EP to the edge A of the screen of LCD in a flat surface including the normal stood to the front face of the polarizing filter 6 by which **** arrangement was carried out, and an optical axis In addition, θ_1 , The intersection of this beam of light and polarizing filter 6 The side which has Intersection P on both sides of the optical axis in the point that only distance l left the distance between H and Intersections P and H from Intersection H, from h_p and Intersection H in the intersection of the perpendicular and optical axis which were given from P and this intersection P to the optical axis sets the height to the reverse near equipment frame F to h_l in the range to an eye point EP. the minimum value of the value expressed with $\tan^{-1} (h_p + h_l) / l$ -- θ_2 -- the time of carrying out -- $(\theta_1 + \theta_2) / 2 < \theta < 85$ degrees -- it is selected so that conditions may be satisfied.

[0022] In EVF, since observation for a high scale factor is enabled more, optical members, such as a diffraction grating, may be used. The example using this is explained below as the 4th, 5, and 6 examples.

[0023] Drawing 4 shows the 4th example of this invention. This example differs from the 1st example in that the dot eraser filter (filter which cuts the frequency component corresponding to the dot space of the image which consists of points (dot)) 7 is joined to the liquid crystal cell 3 instead of the polarizing plate 4 in LCD. Also in this case, like the 2nd example, a polarizing filter 6 is in the side nearest to an eye, and about 1/ of effects of reflection of each side of an optical member is set to 3.

[0024] Drawing 5 shows the 5th example of this invention. This example differs from the 4th example in having made it not go into an eye, even if it has leaned and

arranged and outdoor daylight reflected on that front face so that the normal which stood the polarizing filter 6 to that front face might make θ (about about 45 degrees) to an optical axis. The advantage in this case is the same as that of the case of the 3rd example, and the selection conditions of θ of it are the same as that of the case of the 3rd example.

[0025] Drawing 6 shows the 6th example of this invention. This example is the point which separated the dot racer filter 7 from the liquid crystal cell 3, joined to the polarizing filter 6, and has arranged this between LCD and a lens 5, and differs from the 5th example. In this case, the air contact surface of an optical member can be reduced by junction, and effect of reflective of the eye side front face of a liquid crystal cell 3 can be set to one third.

[0026] Drawing 7 shows the 7th example of this invention. This example is the point of having joined in order and having used a convex-plano lens 8, the polarization film 9, and a plano-convex lens 10 instead of the lens 5 and the polarizing filter 6, and differs from the 2nd example. In this case, the air contact surface can be reduced by being able to set effect of reflection of each side of a lens 8 and a liquid crystal cell 3 to one third, and using junction. In addition, the polarization film 9 is very thin, and the joined lens is fabricated so that it may become the lens 5 and equivalence in said each example.

[0027] Drawing 8 shows the 8th example of this invention. This example is the point that make one field of a lens 11 into a flat surface, and the polarizing filter 6 is joined by that flat surface, and differs from the 7th example. In this case, effect of reflective of a lens and an optical member can be set to one third like the 7th example.

[0028] Furthermore, it explains below by making the example also in consideration of reflection by the electrode inside the liquid crystal cell of LCD etc. into the 9th example. Drawing 9 shows the 9th example of this invention. This example differs from said any example in that the quarter-wave length plates 12 and 13 are made to intervene, respectively between a liquid crystal cell 3 and polarizing plates 2 and 4, and the polarizing filter 6 is not used for it in LCD. In this case, since 90 degrees of planes of vibration rotate, the light which penetrated the polarizing plate 4 and was reflected among the quarter-wave length plates 13 and 12 can hardly penetrate a polarizing plate 4. Therefore, the effect by reflection of the light by the electrode of the liquid crystal cell 3 interior etc. can also be lost mostly. The polarization shaft orientation of a polarizing plate and 45 degrees of shaft orientations of a quarter-wave length plate are shifted. Moreover, as a wavelength plate, although $\lambda(2n+1)/4$ ($n=0, 1, 2$ and $3, \dots$) of wavelength plates can be used, in order to reduce a wavelength property, $\lambda/4$ wavelength plate is desirable.

[0029] Drawing 12 shows the 10th example of this invention. It leans and this example is arranged so that the normal which stood LCD to that front face may make θ (about 20 degrees) to an optical axis, and it differs from said any example in having

made it not go into an eye, even if outdoor daylight reflected on that front face. It can avoid going the reflected light from a LCD front face and the interior into an eye according to this example, without increasing a member. In this case, in order to lessen effect of the diopter gap by the inclination of the image surface, the smaller one of the value of theta is desirable.

[0030] It will be as follows if the numeric data of the lens used in each example above is shown. Lens 5fB =41.00R1 =32.72 D 1 = 4.8 n= 1.56384 nu=60.69 R2 =-87.40 (aspheric surface)

E=0.115 x10⁻⁴ D1 =1.8 n=1.56384 nu=60.69 R2 =-87.40 (aspheric surface) F=-0.2457 x10⁻⁷G=-0.7378 x10⁻¹⁰ H=0.3220x10⁻¹² lens 8fB =41.00R1 =32.72 D 1 = 3.0 n= 1.56384 nu=60.69 R2 =infinity lens 10R1 =infinity

E= 0.115x10⁻⁴ F=-0.2457 x10⁻⁷G=-0.7378 x10⁻¹⁰ H=0.3220x10⁻¹² lens 11fB =43.00R1 =23.956 (aspheric surface) D 1 = 5.0 n= 1.56384 nu=60.69 E=0.1298x10⁻⁴ F=-0.1049 x10⁻⁸G=0.8035x10⁻¹¹ R2 =infinity -- however fB The distance (F back) from the plane peak by the side of LCD of a lens to a liquid crystal cell (image surface), R1, and R2 Radius of curvature and D1 Thickness and n are [the Abbe number, and E, F, G and H of a refractive index and nu] aspheric surface multipliers.

[0031] Although one lens was used in each above-mentioned example, it may replace with this and a lens system may be used, and a lens (lens system) may be moved forward and backward, a diopter compensation device may be added, a mirror is further inserted in a finder system, and you may enable it to constitute an optical path for the whole bending equipment in a compact.

[0032]

[Effect of the Invention] Like ****, according to this invention, compared with the image constituted by polarization, the reflected light by the outdoor daylight produced in the backside [polarizing plate] can be decreased sharply, the S/N ratio of an image can be raised, and very legible image observation equipment can be offered cheaply.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1.] It is the side elevation showing the 1st example of this invention.

[Drawing 2] It is the side elevation showing the 2nd example of this invention.

[Drawing 3] It is the side elevation showing the 3rd example of this invention.

[Drawing 4] It is the side elevation showing the 4th example of this invention.

[Drawing 5] It is the side elevation showing the 5th example of this invention.

[Drawing 6] It is the side elevation showing the 6th example of this invention.

[Drawing 7] It is the side elevation showing the 7th example of this invention.

[Drawing 8] It is the side elevation showing the 8th example of this invention.

[Drawing 9] It is the side elevation showing the 9th example of this invention.

[Drawing 10] It is drawing for explaining the inclination conditions of the polarizing filter in the 3rd example and the 5th example of this invention.

[Drawing 11] It is drawing for explaining the inclination conditions of an image display device.

[Drawing 12] It is the side elevation showing the 10th example of this invention.

[Description of Notations]

1 Back Light

2 Four Polarizing plate

3 Liquid Crystal Cell

5, 8, 10, 11 Lens

6 Polarizing Filter

7 Dot Racer Filter

9 Polarization Film

F Equipment frame

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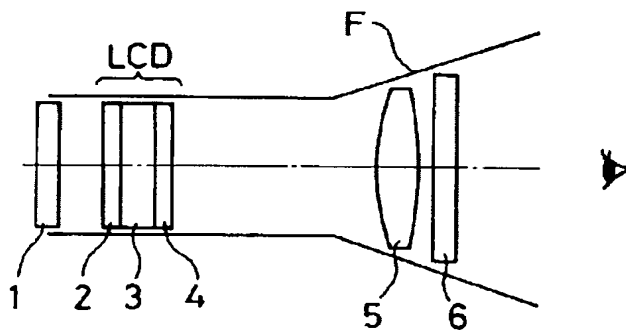
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(54)【発明の名称】 画像観察装置

(57)【要約】

【目的】 外光の反射を低減させて画像の見えを良くすることのできる画像観察装置を提供する。

【構成】 装置枠(F)内に、バックライト(1)と、液晶表示装置(LCD)と、レンズ(5, 8, 10, 11)と、偏光素子(6, 9)が順次配列されている。偏光素子は、眼に最も近い位置に配置されるか、液晶表示装置とレンズの間に光軸に対して垂直又は傾けて配置されるか、レンズと接合した状態で配置されている。



【特許請求の範囲】

【請求項1】 偏光により画像を構成する表示装置と観察者の眼との間に少なくとも一つの光学系を配置して成る画像観察装置において、前記光学系と眼との間に偏光素子を配置したことを特徴とする画像観察装置。

【請求項2】 二枚の偏光素子を含んでいて、該二枚の偏光素子の間に画像を形成する液晶セルと光学系を配置して成る画像観察装置。

【請求項3】 三枚の偏光素子を含んでいて、該三枚の偏光素子の内の一枚は画像を形成する液晶セルと光学系との間に配置されている画像観察装置。

【請求項4】 眼側から一枚目と二枚目の前記偏光素子は、偏光方向が実質上平行になるように配置されている、請求項3に記載の画像観察装置。

【請求項5】 前記光学系は単一のガラスレンズから成っている請求項1乃至4の何れかに記載の画像観察装置。

【請求項6】 二枚の偏光素子と該二枚の偏光素子の間に配置された画像を形成する液晶セルと光学系とを含んでいて、前記偏光素子と前記液晶セルとの間に、 $(2n+1)\lambda/4$ (但し、 $n=0, 1, 2, 3, \dots$ 、 λ =光の波長)の位相差を生じさせる波長板を夫々配置して成る画像観察装置。

【請求項7】 二枚の前記波長板は、軸方向が平行又は直交していて、前記偏光板に対し 45° の角度をなすように配置された、請求項6に記載の画像観察装置。

【請求項8】 偏光により画像を形成するためバックライトと偏光板と液晶セルを備えた表示装置と、該表示装置よりも眼側で表面に立てた法線が光軸に対して以下の条件を満足する角度 θ をなして傾斜するように配置された偏光素子と、接眼レンズとから成る画像観察装置。

$$(\theta_1 + \theta_2) / 2 < \theta < 85^\circ$$

但し、 θ_1 は斜向配置された偏光板の上記法線と光軸とを含む平面においてアイポイントより画面の端へ入射する光線の入射角、 θ_2 は、画面の端へ入射する前記光線と偏光板との交点をP、交点Pから光軸へ下した垂線と光軸との交点をH、交点PとHとの間の距離を h_p 、交点Hよりアイポイントまでの範囲で交点Hより距離 l だけ離れた点での光軸を挟んで交点Pがある側とは反対の側の装置枠までの高さを h_l としたとき、 $\tan^{-1}(h_p + h_l) / l$ で表わされる値の最小値である。

【請求項9】 偏光により画像を形成するためバックライトと液晶表示装置と接眼レンズから成り、該液晶表示装置の表面に立てた法線が光軸に対して、以下の条件を満足する角度 θ をなして傾斜するよう、該液晶表示装置を配置した画像観察装置。

$$(\theta_1 + \theta_2) / 2 < \theta$$

但し、 θ_1 は斜行配置された液晶表示装置の上記法線と光軸を含む平面においてアイポイントより画面の端へ入射する法線の入射角、 θ_2 は、画面の端の点をR、Rよ

り光軸へ下した垂線と光軸との交点をH'、H'とRとの間の距離を h_r 、交点H'よりアイポイントまでの範囲で交点H'より距離 m だけ離れた点での光軸を挟んで点Rがある側とは反対の側の装置枠までの高さを h_m としたとき、 $\tan^{-1}(h_r + h_m) / m$ で表わされる値の最小値である。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、液晶表示装置等によって形成された像を光学系を介して観察できるようにしたカムコーダー用ファインダーやスチルビデオファインダーの如き画像観察装置に関する。

【0002】

【従来の技術】この種の画像観察装置においては、外部から装置内部へ光が入ると、その反射光のために像が見難くなる。そのため、従来、フード部分を改良して外光が装置内部へ入射しないようにするか、又は装置内部の反射面に反射防止膜等を施して反射率を減らす等の対策がとられていた。

【発明が解決しようとする課題】

【0003】電子映像分野のカメラにおいては、従来からCRTやLCD等の画面を光学系で拡大して見る方式のファインダーが用いられて来た。然し、CRTに比べて画面の暗いLCDにおいては、上記のような反射率を減らす等の対策を講じたとしても、尚ファインダーレンズ面やLCD表面による外光の反射が無視できず問題となっている。

【0004】又、実開平1-146227号において提案された如き遮光板とフードを用いる方式の場合には、ファインダー内への外光の進入を効率良く防止するためには遮光板をより大きくしなければならないが、これはファインダー装置の取り扱いや持ち運びを不便にするばかりか、観察時に観察者の皮膚に直接触れる部分が多くなり、観察者に不快感を与えると云う問題点がある。又、反射防止膜を用いるとコストアップになると云う問題もある。

【0005】本発明は、従来の技術の有するこのような問題点に鑑みてなされたものであり、その目的とするところは、内部に進入した外光の反射をより低減させて画像の見えを向上させることのできる画像観察装置を提供することにある。

【課題を解決するための手段】

【0006】上記目的を達成するために、本発明による画像観察装置は、液晶セルの如き画像表示装置と、画像表示装置と観察者の眼との間に配置された少なくとも一つの光学系と、該光学系と眼との間に配置された偏光素子とを備えている。

【0007】偏光素子は液晶セルと光学系を挟むような配置で二枚用いられてもよいし、液晶セルと光学系の間に更に一枚の偏光素子を介在させた配置で三枚用いられ

てもよい。この場合、眼側から一枚目と二枚目の偏光素子は偏光方向が実質上平行になるように配置されている。又、光学系は単一のガラスレンズであり、偏光素子と表示装置との間には $(2n+1)\lambda/4$ (但し、 $n=0, 1, 2, 3, \dots, \lambda=\text{光の波長}$) の位相差を生じさせる波長板が配置されていてもよい。更に、二枚の波長板は軸方向が平行又は直交して偏光板に対し 45° の角度をなすように配置される。

【0008】更に、偏光素子は表示装置よりも眼側で表面に立てた法線が光軸に対して $(\theta_1 + \theta_2)/2 < \theta < 85^\circ$ なる条件を満足する角度 θ をなして傾斜するように配置され得る。但し、 θ_1 は斜向配置された偏光板の上記法線と光軸とを含む平面においてアイポイントより画面の端へ入射する光線の入射角、 θ_2 は、画面の端へ入射する前記光線と偏光板との交点をP、交点Pから光軸へ下した垂線と光軸との交点をH、交点PとHとの間の距離を h_p 、交点Hよりアイポイントまでの範囲で交点Hより距離 l だけ離れた点での光軸を挟んで交点Pがある側とは反対の側の装置枠までの高さを h_l としたとき、 $\tan^{-1}(h_p + h_l)/l$ で表わされる値の最小値とする。又、この場合、偏光板はその透過軸が上記法線と光軸とを含む面内にあるよう配置される。

【0009】画像表示装置は、その表面の法線と光軸との角 θ が $(\theta_1 + \theta_2)/2 < \theta$ なる条件を満足するよう傾斜して配置され得る。但し、 θ_1 は斜向配置された表示装置の上記法線と光軸とを含む平面においてアイポイントより画面の端へ入射する光線の入射角、 θ_2 は、画面の端へ入射する前記光線の画面との交点をR、交点Rから光軸へ下した垂線と光軸との交点をH'、交点RとH'との間の距離を h_r 、交点H'よりアイポイントまでの範囲で交点H'より距離 m だけ離れた点での光軸を挟んで交点Rがある側とは反対の側の装置枠までの高さを h_m としたとき、 $\tan^{-1}(h_r + h_m)/m$ で表わされる値の最小値とする。

【0010】

【作用】カムコーダー用ファインダーやスチルビデオファインダーのような電子ファインダー（以下、EVFと云う）において、見えにくさの一因となる外光の反射は、主にレンズ表面と表示装置の表面からのものである。本発明によれば、EVFにおいて偏光素子が液晶表示装置（以下、LCDと云う）よりも眼に近い側に配置されているから、観察すべき画像を形成する光を減衰させずに外光とその反射光を減衰させることができ、見えを向上させるものである。

【0011】即ち、図1に示すように、光学系としてのレンズ5と眼との間に、LCDを構成する液晶パネル3の眼側の偏光板4と同じ向きに偏光軸の揃えられた偏光フィルター6を配置して、従来のEVFにおいて眼側から入射した外光がEVF内部で反射して眼に入ってくる光の強度をR、LCDから出て眼に入ってくる光の強度

をS、偏光フィルター6の透過率をT、偏光フィルター6の平行透過率（偏光軸と平行な偏光の透過率）を T_p とすると、外光はEVFへの入射時と内部で反射して外部へ射出する時の2回偏光フィルター6を透過することになるので、その強度Nは $T \times T_p \times R$ となる。一方、LCDから出た光は既に偏光となっているので偏光フィルター6を透過した後の強度Sは $T_p \times I$ となる。ここで、S/N比をとると、 $(T_p \times I) / (T \times T_p \times R) = (1/T) (I/R)$ となり、 $T < 1$ であるのでS/N比は向上する。

【0012】又、上記構成において、液晶パネル3の眼側にはレンズ5を挟んで偏光軸を同じ向きに揃えた偏光素子が二枚あるが、像を見るためにはこの内の一枚があればよいので、図2に示すようにLCDを構成する眼側の偏光板4は取り除いてもよい。取り除いた偏光板4の作用は偏光フィルター6により代行することができ、この場合像の光の強さは図1の場合と同じくIとなる。ここでS/N比をとると、 $I / (T \times T_p \times R) = \{1 / (T \times T_p)\} \cdot (I/R)$ となり、 $T_p < 1$ であるので、S/N比はより向上する。

【0013】上記のようにEVFの最も眼に近い側に偏光素子を配置することにより、EVFへの入射光と反射光を減衰させ、像のS/N比を向上させて、見えを良くすることができる。

【0014】又、図9に示すように、LCDを、バックライト1側から眼側へ向けて順次配列された偏光板2、 $(2n+1)\lambda/4$ 波長板12 ($n=0, 1, 2, 3, \dots, \lambda=\text{光の波長}$)、液晶セル3、 $(2m+1)\lambda/2$ 波長板13 ($m=0, 1, 2, 3, \dots$) 及び偏光板4で構成すれば、眼側から入射して偏光板4を透過した光のうち、像を観察する上で有害となる液晶セル3の後面より眼側にある面からの反射光は、波長板13を2回通ることになり、偏光面の向きが 90° 回転するので、偏光板4で殆ど吸収される。これにより、液晶セル3内部での反射も減少させることができる。一方、バックライト1側の光は、偏光板2を通ることにより直線偏光となり、波長板12を通過することにより円偏光となるが、波長板13を通過することにより再び直線偏光となり、偏光板4に入射するので従来と同様に画像を得ることができる。

【0015】又、図10に示すように、偏光板6の表面に立てた法線と光軸とのなす角 θ が条件式 $(\theta_1 + \theta_2)/2 < \theta < 85^\circ$ を満たす時、アイポイントEPから出てファインダー内に入射し偏光板6の表面で反射した光は、枠に当り外に出ることはない。逆に考えると、外から入射した光が偏光板6の表面で反射しても、その光が眼に入ることはない。但し、 θ_1 は斜向配置された偏光板の上記法線と光軸とを含む平面においてアイポイントより画面の端へ入射する光線の入射角、 θ_2 は、画面の端へ入射する前記光線と偏光板との交点をP、交点

Pから光軸へ下した垂線と光軸との交点をH、交点PとHとの間の距離を h_p 、交点Hよりアイポイントまでの範囲で交点Hより距離 l だけ離れた点での光軸を挟んで交点Pがある側とは反対の側の装置枠までの高さを h_l としたとき、 $\tan^{-1}(h_p + h_l) / l$ で表わされる値の最小値とする。更に、表面での反射率は入射角度に依存し、光の振動方向により異なる値をとる。反射面に平行なS成分は、入射角が増加するに従い単調に増加し、一方、反射面の法線と入射光線を含む面に含まれるP成分は、入射角が増えるに従い一時減少し、入射角が $\tan^{-1}n$ (n は偏光板6の屈折率)と等しくなる時0となる。その後は単調に増加するが、入射角が 0° から 90° の範囲でS成分 \geq P成分となる。又、偏光板6の透過軸をP成分となる方向に揃えることにより、傾けた偏光板6のP成分の透過率は、 $\theta = \tan^{-1}n$ 付近で最大となり、コーティングを施さなくても十分な透過率を得ることが出来る。同時に、S成分を含んでいる外光の透過率は、 θ が増えるにつれて減少するので、偏光板6よりLCD側にある反射面による反射は減少する。

【0016】又、図11に示すように、画像表示装置(LCD)の表面に立てた法線と光軸とのなす角を θ とし、 $\theta > (\theta_1 + \theta_2) / 2$ なる条件を満足する時、
 単体透過率(T_p) 43%
 直交透過率(T_c) 4.2%

【0018】外光は、眼の側から装置枠Fの内部に入射し、偏光フィルター6を透過し、内部で反射し再び偏光フィルター6を透過して眼に入る。従って、反射光は2回偏光フィルター6を通ることになり、光の強さは33.5%に減少する。一方、LCDからの光も偏光フィルター6を通して眼に入るため、その光の強さは従来(無対策時)とは異なり81.8%に減少する。従って、無対策時のS/N比を1と置くと本実施例の場合のS/N比は2.44となり、S/N比が著しく向上することが分かる。尚、偏光フィルター6の表面反射を防ぐため、偏光フィルター6の表面には反射防止膜を施した。本実施例は、従来のLCDを用いたEVFに偏光フィルターを付加するだけで済むから、極めて容易且つ安価に実施することができる。

【0019】図2は本発明の第2実施例を示している。この実施例は、LCDから偏光板4が除去されている点で第1実施例とは異なる。従って、偏光板2と液晶セル3の表面反射率が同じであるとする、眼に入る外光による反射光の強さは第1実施例の場合と同様に33.5%に減少する。一方、LCDからの光は、無対策時の構成でLCDの眼側の偏光板がレンズの前側に移動したものと同様に考えられるので、強度の変化は無いと考え、S/N比は2.99となり、第1実施例よりもS/N比が更に向上する。

【0020】第2実施例では、像の明るさを減少させることなく外光による反射光のみを低減することができる

イポイントから出てファインダーに入射し画像表示装置の表面及び内部で反射した光は、枠にあたり外に出ることはない。逆に考えると、外から入射した光が画像表示装置の表面及び内部で反射しても、その光が眼に入ることではない。但し、 θ_1 は斜行配置された表示装置の上記法線と光軸を含む平面において、アイポイントより画面の端へ入射する光線の入射角、 θ_2 は、画面の端の点をR、Rより光軸へ下した垂線と光軸との交点をH'、H'とRとの間の距離を h_r 、交点H'よりアイポイントまでの範囲で交点H'より距離 m だけ離れた点での光軸を挟んで点Rがある側とは反対の側の装置枠までの高さを h_m とした時、 $\tan^{-1}(h_r + h_m) / m$ で表わされる値の最小値とする。

【0017】

【実施例】図1は本発明の第1実施例を示している。図中、Fは装置枠、1はバックライト、2は偏光板、3は液晶セル、4は偏光板、5はガラスレンズ、6は偏光フィルターである。この場合、偏光板2、4及び偏光フィルター6の各偏光面は同じ方向に揃えられており、偏光フィルター6としては下記の特性を有するものが使用された。尚、偏光板2、4と液晶セル3はLCDを構成している。

平行透過率(T_p) 81.8%

偏光度 95%

ばかりか、LCD部の部品点数を減らすこともできるので、その効果は大である。本実施例では、光学系の複屈折による影響を防ぐため、ガラス又はアクリル等の複屈折の生じ難い材料で光学部品を構成すると良い。又、外光が観察者の顔面で1度反射した後EVF内へ入射する場合は部分偏光となっているので、その偏光方向と直交する方向に偏光フィルター及び偏光板を配置することにより、一層効率良く眼に入る外光を減少させることができる。

【0021】図3は本発明の第3実施例を示している。この実施例は、偏光フィルター6をその表面に立てた法線が光軸に対し θ° (ほぼ 45° 程度)をなすように傾けて配置して外光がその表面で反射しても眼に入らないようにした点で、第2実施例とは異なる。このように偏光素子を傾けることにより、眼側から入射した外光のうち偏光素子の表面で反射した光は装置枠Fの壁に当り吸収されるため、偏光素子を付加した場合でもそれによる反射面の増加の影響を減らすことができる。偏光フィルター6より後側(バックライト1側)の面については第2実施例と同様の効果がある。尚、上記 θ は、図10に示すように、斜向配置された偏光フィルター6の表面に立てた法線と光軸とを含む平面においてアイポイントEよりLCDの画面の端Aへ入射する光線の入射角を θ_1 、この光線と偏光フィルター6との交点をP、この交点Pから光軸へ下した垂線と光軸との交点をH、交点PとHとの間の距離を h_p 、交点HよりアイポイントE

までの範囲で交点Hより距離1だけ離れた点での光軸を挟んで交点Pがある側とは反対の側の装置枠Fまでの高さを h_1 として $\tan^{-1}(h_p + h_1)/1$ で表わされる値の最小値を θ_2 としたとき、 $(\theta_1 + \theta_2)/2 < \theta < 85^\circ$ なる条件を満足するように選定される。

【0022】EVFにおいて、より高倍率での観察を可能とするため、回折格子等の光学部材を用いることができる。これを用いた実施例が、第4、5及び6実施例として以下に説明される。

【0023】図4は本発明の第4実施例を示している。この実施例は、LCDにおいて偏光板4の代わりにドットレイサフィルター（点像（ドット）で構成されている画像のドット間隔に対応する周波数成分をカットするフィルター）7が液晶セル3に接合されている点で第1実施例とは異なる。この場合も、第2実施例と同様に偏光フィルター6が眼に最も近い側に在り、光学部材の各面の反射の影響は約1/3となる。

【0024】図5は本発明の第5実施例を示している。この実施例は、偏光フィルター6をその表面に立てた法線が光軸に対し θ° （ほぼ 45° 程度）をなすように傾けて配置して外光がその表面で反射しても眼に入らないようにした点で第4実施例とは異なる。この場合の利点は第3実施例の場合と同様であり、 θ の選定条件も第3実施例の場合と同じである。

【0025】図6は本発明の第6実施例を示している。この実施例は、ドットレイサフィルター7を液晶セル3から離して偏光フィルター6と接合しこれをLCDとレンズ5との間に配置した点で、第5実施例とは異なる。この場合は、接合により光学部材の空気接触面を減らすことができ、液晶セル3の眼側表面の反射の影響を1/3にすることができる。

【0026】図7は本発明の第7実施例を示している。この実施例は、レンズ5と偏光フィルター6の代わりに凸平レンズ8と偏光膜9と平凸レンズ10を順に接合して用いた点で、第2実施例とは異なる。この場合は、レンズ8及び液晶セル3の各面の反射の影響を1/3にすることができ、又接合を用いていることにより空気接触面を減らすことができる。尚、偏光膜9は非常に薄く、接合したレンズは前記各実施例におけるレンズ5と等価になるように成形されている。

【0027】図8は本発明の第8実施例を示している。この実施例は、レンズ11の一方の面を平面にしてその平面に偏光フィルター6が接合されている点で、第7実施例とは異なる。この場合は、第7実施例と同様にレンズ、光学部材の反射の影響を1/3にすることができる。

【0028】更に、LCDの液晶セルの内部の電極等による反射も考慮した実施例を第9実施例として以下に説明する。図9は本発明の第9実施例を示している。この実施例は、LCDにおいて液晶セル3と偏光板2及び4

との間に1/4波長板12及び13が夫々介在せしめられていて、偏光フィルター6が用いられていない点で前記何れの実施例とも異なる。この場合、偏光板4を透過して1/4波長板13と12の間で反射した光は、振動面が 90° 回転するので、偏光板4を殆ど透過することはできない。従って、液晶セル3内部の電極等による光の反射による影響もほぼ無くすることができる。偏光板の偏光軸の方向と1/4波長板の軸方向とは 45° ずらされている。又、波長板としては、 $(2n+1)\lambda/4$ （ $n=0, 1, 2, 3, \dots$ ）の波長板を用いることができるが、波長特性を減らすために $\lambda/4$ 波長板が好ましい。

【0029】図12は本発明の第10実施例を示している。この実施例は、LCDをその表面に立てた法線が光軸に対し θ° （ 20° 程度）をなすように傾けて配置して、外光がその表面で反射しても眼に入らないようにした点で前記何れの実施例とも異なる。本実施例によれば、部材を増やすことなくLCD表面及び内部からの反射光を眼に入らないようにすることが出来る。この場合、像面の傾きによる視度ずれの影響を少なくするために、 θ の値は小さい方が望ましい。

【0030】以上各実施例において用いたレンズの数値データを示せば下記の通りである。

レンズ5

$f_B = 41.00$
 $R_1 = 32.72$ $D_1 = 4.8$ $n = 1.56384$ $v = 60.69$
 $R_2 = -87.40$ （非球面）
 $E = 0.115 \times 10^{-4}$ $F = -0.2457 \times 10^{-7}$
 $G = -0.7378 \times 10^{-10}$ $H = 0.3220 \times 10^{-12}$

レンズ8

$f_B = 41.00$
 $R_1 = 32.72$ $D_1 = 3.0$ $n = 1.56384$ $v = 60.69$
 $R_2 = \infty$

レンズ10

$R_1 = \infty$ $D_1 = 1.8$ $n = 1.56384$ $v = 60.69$
 $R_2 = -87.40$ （非球面）
 $E = 0.115 \times 10^{-4}$ $F = -0.2457 \times 10^{-7}$
 $G = -0.7378 \times 10^{-10}$ $H = 0.3220 \times 10^{-12}$

レンズ11

$f_B = 43.00$
 $R_1 = 23.956$ （非球面） $D_1 = 5.0$ $n = 1.56384$
 $v = 60.69$
 $E = 0.1298 \times 10^{-4}$ $F = -0.1049 \times 10^{-8}$
 $G = 0.8035 \times 10^{-11}$
 $R_2 = \infty$

但し、 f_B はレンズのLCD側の面頂位置から液晶セル（像面）までの距離（Fバック）、 R_1 、 R_2 は曲率半

径、 D_1 は厚さ、 n は屈折率、 v はアッペ数、 E 、 F 、 G 、 H は非球面係数である。

【0031】 上記各実施例では1枚のレンズを用いたが、これに代えてレンズ系を用いてもよく、又レンズ（レンズ系）を前後に動かして視度補正機構を付加してもよいし、更にファインダー系にミラーを挿入して光路を曲げ装置全体をコンパクトに構成できるようにしてもよい。

【0032】

【発明の効果】 上述の如く本発明によれば、偏光によって構成されている像に比べて、偏光板より後側で生じる外光による反射光を大幅に減少させることができ、像の S/N 比を向上させ、極めて見易い画像観察装置を安価に提供することができる。

【図面の簡単な説明】

【図1】 本発明の第1実施例を示す側面図である。

【図2】 本発明の第2実施例を示す側面図である。

【図3】 本発明の第3実施例を示す側面図である。

【図4】 本発明の第4実施例を示す側面図である。

【図5】 本発明の第5実施例を示す側面図である。

【図6】 本発明の第6実施例を示す側面図である。

【図7】 本発明の第7実施例を示す側面図である。

【図8】 本発明の第8実施例を示す側面図である。

【図9】 本発明の第9実施例を示す側面図である。

【図10】 本発明の第3実施例と第5実施例における偏光フィルターの傾斜条件を説明するための図である。

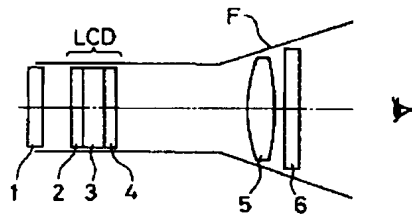
【図11】 画像表示装置の傾斜条件を説明するための図である。

【図12】 本発明の第10実施例を示す側面図である。

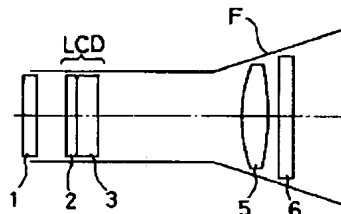
【符号の説明】

- | | |
|--------------|-------------|
| 1 | バックライト |
| 2, 4 | 偏光板 |
| 3 | 液晶セル |
| 5, 8, 10, 11 | レンズ |
| 6 | 偏光フィルター |
| 7 | ドットレイサフィルター |
| 9 | 偏光膜 |
| F | 装置枠 |

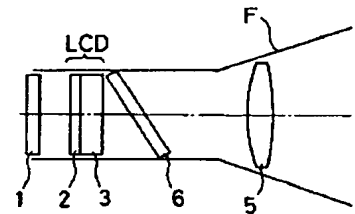
【図1】



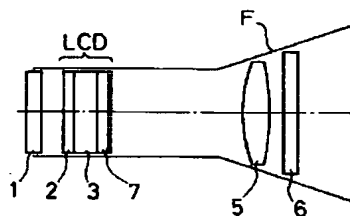
【図2】



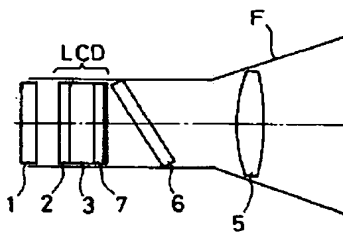
【図3】



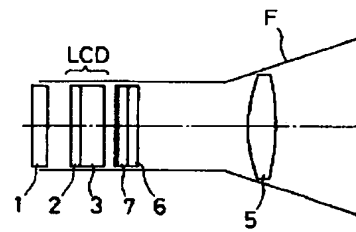
【図4】



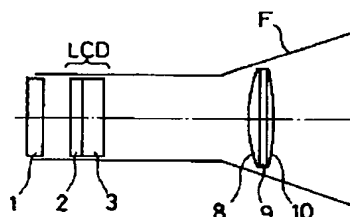
【図5】



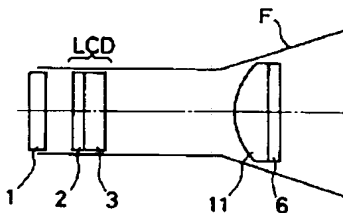
【図6】



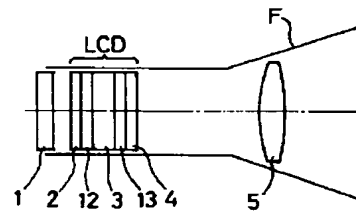
【図7】



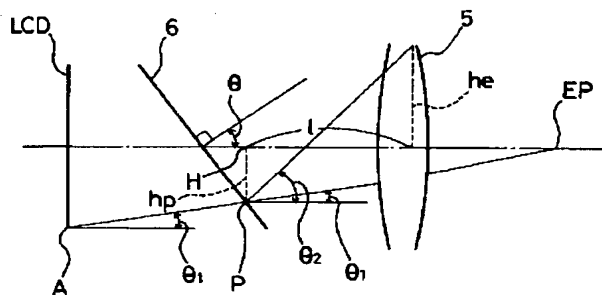
【図8】



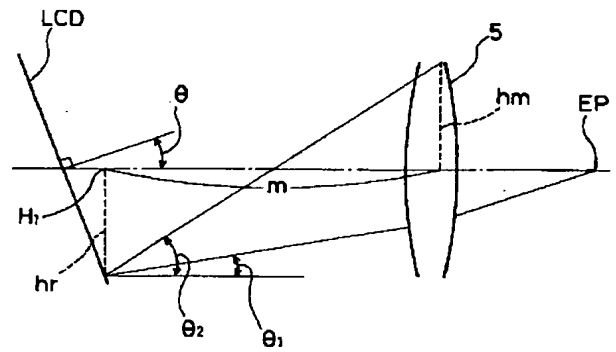
【図9】



【図10】



【図11】



【図12】

